Research Article

Nutritional and Functional Evaluation of Wheat Flour Biscuits Supplemented with Lentil Flour

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Abstract | Evaluation of nutritional and sensory properties of biscuits produced from wheat; lentil flour was investigated in this study. This study showed significant (P<0.05) variation in physico-chemical characteristics of four lentil varieties. The NIA-Masoor variety showed higher values for ash, fat and fiber (3.02%, 3.02% and 10.99%) respectively. Whereas; PM-09 possessed higher moisture (13.89%); though Masoor-93 was higher in protein content (25.16%) than all other varieties. The supplementation resulted in a significant increase in protein, fat, crude fiber and ash contents of the biscuits. The thickness and spread factor of biscuits differ significantly while non-significant effect was observed in the width of the biscuits. Sensory analysis revealed that there were no significant differences (p>0.05) amongst all treatments. The study concluded that biscuits might be prepared from lentil flour especially at the level of 21 and 28% considered most excellent by the panelists with respect to all sensory attributes. The biscuits supplemented with wheat; lentil flour at all proportion ratios was found to be acceptable for sensory quality.

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Introduction

Lentil (*Lens culinaris*) is an important crop used predominantly as a human food source. Lentil is the second largest grown legume crop in Pakistan after chickpea (Ayub et al., 2001) and was cultivated on an area of 17.8 thousand hectares with a production of 9.3 thousand tons (GOP, 2014). It is one of the prominent sources of plant proteins, having a protein content of 21–31% (w/w) (Urbano et al., 2007). Storage proteins of lentils consist of about 80% (w/w) of total seed proteins and are mainly composed of globulins (Adsule and Kadam, 1989). Lentil contains about 25g proteins, 5g carbohydrates, 1.0g fats, 2.6g ash and 31g fiber per 100g of the seed. Legume proteins are considered to be one of the best and cheapest sources of vegetable proteins, such as essential amino acid lysine (Marcello et al., 1997).

Malnutrition due to protein deficiency is an antrocious dilemma among the masses whose diet is generally based on cereals (Barker, 2002; Reilly, 2002). Feeding on protein deficient diets can lead towards many disorders such as colon cancer, heart disease and osteoporosis (Alam et al., 2003, Bhan et al., 2003). Therefore, the utilization of protein-enriched diet

is important to fight against infections and diseases as it facilitates production of antibodies to activate our immune system (Friedman, 1996; Alexander et al., 1998). (Bakery products of cereals are often the mainstay of emergency feeding programs designed to serve large number of people due to the cheap nutritional source of calories and protein, (Akhtar et al., 2009). However, the prolonged consumption of diet consisting mainly of cereal grains leads to multiple nutritional deficiencies, because cereals fail to supply sufficient amounts of certain essential nutrients such as amino acids, minerals and vitamins (Noor Aziah et al., 2012).

Biscuit is a popular bakery product but low in protein, fiber, minerals and vitamins which make it unhealthy for daily use (Tsen et al., 2006). Biscuits are ready-to-eating, cheap and conveniently eating food among all age groups (Hussein et al., 2006). Because of its acceptability in all age group, longer shelf life, it is considered as a good product for protein fortification and other nutritional improvement. The composite flour containing legume flour along with wheat flour can effectively increase nutritional value and functional properties of the wheat flour (Shahzadi et al., 2005). The fortification of staples, widely consumed and accessible with food materials rich in proteins and micronutrients, is one of the main strategies adopted for the improvement of the nutritional quality of people in rural areas in developing countries (Abdel-Kader, 2000). For the young children, fortified biscuits and cookies are largely used as a way of solving the crucial problem of malnutrition. Biscuits are indeed very popular and delighted by children worldwide owing to their sweet taste.

Therefore, the goal of this study was to formulate protein-rich lentil seed flour-incorporated into wheat flour based biscuits which can be consumed as protein, dietary and micronutrient supplement. Thus, wheat-flour and composite flour based-biscuits, were prepared using blend of fine wheat flour and lentil flour in proportions of (100:0, 93:7, 86:14, 79:21, 72;28) and their physicochemical and sensory properties were evaluated.

Materials and Methods

Raw materials

Four lentil varieties were selected for this study. Two lentil varieties (Masoor-93 and NIA-Masoor) were collected from Nuclear Institute of Agriculture (NIA) Tandojam, while other two varieties (Masoor, 2004 and Punjab Masoor) were collected from National Agriculture Research Center Islamabad (FSPDI). The wheat flour (Maeda) was purchased from local market of Islamabad. These samples were packed in plastic bags and were labeled and transported to Food Sciences and Product Development Institute, National Agriculture Research Center (NARC) Islamabad. All the other ingredients for the preparation of cookies were purchased from the local market. Proximate analysis such as moisture, fat, ash, protein and fiber content of lentils and composite flours were determined by AACC (2000).

Preparation of composite flours

All lentil varieties were grind into flour for making composite flour. Composite flour was prepared by replacing patent flour with lentil with different proportions whereas T_1 was kept as control (whole wheat flour) and remaining treatments were based on partial replacement of wheat with lentil flour; which were packed in polypropylene bags. The details of treatments are as under:

Factor-A (Lentil varieties) 4

V1= Masoor-93; V2= NIA-Masoor; V3= Punjab Masoor-09; V4= Masoor-2004.

Factor-B (Wheat: lentil flour ratios) 4

R1= 93:7; R2= 86.14; R3= 79:21; R4= 72:28

The biscuits were prepared from wheat and lentil flours at different ratios using different lentil varieties to determine the quality variation.

Preparation of biscuits

High protein biscuits were prepared in FSPDI's kitchen according to standard method as described by American Association of Cereal Chemists (AACC, 2000). The ingredients needed for the preparation of biscuits were accurately weighed by electrical balance. The composite flour and sugar was mixed properly with mixer (Sanyo food factory mixer) after a few minutes of kneading, oil and vanilla essence were added. The composite flour, baking powder, sugar, egg mass and in last milk were added and mixed it. Then batter was rolled out with the help of wooden roller and the flattened dough was round-shaped in several small pastries with the help of a rounded-edged glass and allowed to ferment for 20 to 30 min. After that,

placed in oven at 180°C for 10-15 minutes. After baking the biscuits were allowed to cool at room temperature for 8 to 10 minutes and packed in polythene labeled (date and formulation type), and appropriately stored for further studies.

Treatment combinations

T1= Control	**T10**= V3×R1 (PM-09×93:7)
T2= V1×R1 (Masoor-93×93:7)	**T11**= V3×R2 (PM-09×86:14)
T3= V1×R2(Masoor-93×86:14)	**T12**= V3×R3 (PM-09×79:21)
T4= V1×R3(Masoor-93×79:21)	**T13**= V3×R4 (PM-09×72:28)
T5= V1×R4(Masoor-93×72:28)	**T14**= V4×R1(Masoor-2004×93:7)
T6= V2×R1(NIA Masoor×93:7)	**T15**= V4×R2(Masoor-2004×86:14)
T7= V2×R2(NIAMasoor×86:14)	**T16**= V4×R3(Masoor-2004×79:21)
T8= V2×R3(NIAMasoor×79:21)	**T17**= V4×R4(Masoor-2004×72:28)
T9= V2×R4(NIAMasoor×72:28)	

Physical parameters of lentil seeds

The physical parameters measured in this experiment included lentil seed weight, seed volume, cooking time, density and hydration co-efficient. Seed weight (100) was recorded as the mean weight of randomly selected three replicates each of 100 seeds. 100 seeds were transferred to 250ml measuring cylinder and 30ml distilled water pipette in it, seed volume was recorded as: (Seed volume = Total volume – 30). Cooking time of dry seeds was derived from a boiling and thumb- pressing method according to Williams et al. (1983). Hydration co-efficient was recorded as (weight of 100 soaked seed/ weight of 100 dry seed multiply by 100) and seed density was calculated as the ratio of weight and volume (w/v).

Nutritional evaluation of biscuits

High protein biscuits were analyzed for moisture content, fat, ash, protein and fiber content according to the method as described in AACC (2000).

Physical evaluation of biscuits

Physical characteristics of biscuits (width, thickness and spread factor) were determined according to AACC (2000).

Sensory evaluation of biscuits

The sensory evaluation for color, flavor, texture, taste, appearance and overall acceptability of the biscuits was carried out by the panel of 10 judges. The biscuits prepared from wheat and lentil flours at varied ratios as well as from whole wheat (control) were presented to panel of judges for the offer score for color of the product by a nine-point hedonic scale as described by Amerine et al. (1965). Acceptance testing was used to determine how much each sample was liked based on a 9-point hedonic scale (9 = excellent to 1 = extremely bad).

Statistical analysis

The data obtained were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980).

Results and Discussion

Physical characteristics of lentil seeds are presented in Table 1. The results indicated that Masoor-93, NIA Masoor, PM-09 and Masoor-2004 have seed index value of 2.47, 2.26, 2.77 and 1.91 g respectively. The similar results were also reported by (Khan et al., 1987). Whereas, the results for seed density showed 1.22, 1.11, 1.11 and 0.94 g/ml; for Masoor-93, NIA Masoor, PM-09 and Masoor-2004, respectively. The study revealed significant ($p<0.05$) variation in seed physical characteristics in lentil varieties.

Chemical composition of lentil varieties and flour

The results for the chemical composition of lentil varieties are shown in Table 2. The seed chemical analysis of lentil varieties Masoor-93, NIA-Masoor, PM-09 and Masoor-2004 contained 12.94, 13.23, 13.89 and 13.61% moisture respectively; whereas, protein content was 25.16, 20.66, 20.06 and 19.43%, respectively. However, Masoor-93 contains markedly higher protein, than other lentil varieties. A significant difference ($p<0.05$) was observed between lentil varieties in chemical characteristics.

Chemical composition of flours

The results for the chemical compositions of wheat: lentil flours used for biscuits preparation are shown in Table 3. The analysis of mixed flour samples at different ratios indicated that higher protein content was found in variety Masoor-93 i.e. (12.80%) at the proportion ratio of 72:28 wheat: lentil flour, in NIA-Masoor at 72:28, PM-09 at 72:28 and Masoor-2004 found (11.55%, 11.40% and 11.16% respectively. Wheat: lentil composite flours were significantly ($p<0.050$ associated with lentil flour ratio. Furthermore, the result for the ash, fat content, fiber content was found to be higher in the Masoor-93 comparison with other varieties at the ratio of 72:28, 93:07 and 72:28.

Table 1: *Physical parameters of lentil varieties.*

Lentil varieties	100-Seed weight (g)	Seed density (g/ml)	Seed volume (ml)	Cooking time (min)	Hycration co-efficient
Masoor-93	2.47 b	1.23 a	2.00 b	38.00 a	135.00 a
NIA Masoor	2.27 c	1.12 b	2.00 b	19.00 c	132.33 a
P.M-09	2.77 a	1.12 b	2.50 a	32.00 b	118.00 b
Masoor-2004	1.92 d	0.94 c	2.00 b	16.00 d	127.00 a
SE	0.46	3.71	0.09	0.78	3.37
LSD@5%	0.11	9.10	0.23	1.91	8.25

Table 2: *Chemical analysis of lentil varieties.*

Lentil varieties	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)
Masoor-93	12.94 d	2.87 ab	1.00 b	3.88 d	25.17 a
NIA Masoor	13.23 c	3.02 a	1.17 a	10.99 a	20.67 b
P.M-09	13.89 a	2.92 ab	0.93 bc	9.70 b	20.07 b
Masoor-2004	13.61 b	2.84 b	0.89 c	5.11 c	19.43 b
SE	0.04	0.06	0.03	0.03	0.53
LSD@5%	0.10	0.15	0.08	0.09	1.31

Table 3: *The chemical composition of different flour ratios.*

Wheat lentil flour ratios	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)
$T_{1,}$ Control	13.53 e	0.63 g	1.33 ab	0.00 o	8.03 n
$T_{2,}$ Masoor-93 × 93:7	13.63 d	0.85 e	1.30ab	0.28 n	9.21 k
$T_{3,}$ Masoor-93 × 86:14	13.48 ef	0.89 e	1.28ab	0.55 l	10.40 h
$T_{4,}$ Masoor-93 × 79:21	13.36 gh	1.10 c	1.26bc	0.81 i	11.67 b
$T_{5,}$ Masoor-93 × 72:28	13.67 cd	1.30 a	1.23 de	1.09 h	12.80 a
$T_{6,}$ NIA-Masoor × 93:07	13.79 b	0.88 e	1.34 a	0.77 ij	8.870 l
$T_{7,}$ NIA-Masoor × 86:14	13.33 gh	1.05 cd	1.31 ab	1.54 e	9.77 i
$T_{8,}$ NIA-Masoor × 79:21	13.33 gh	1.24 b	1.30ab	2.31 c	10.66 f
$T_{9,}$ NIA-Masoor × 72:28	13.34 gh	1.21 b	1.28ab	3.08 a	11.55 c
$T_{10,}$ PM-09 × 93:07	13.74 bc	0.74 f	1.30ab	0.68 k	8.87 l
$T_{11,}$ PM-09 × 86:14	13.66 cd	0.90 e	1.27ab	1.36 g	9.70 i
$T_{12,}$ PM-09 × 79:21	13.80 b	1.06 cd	1.24 cd	2.04 d	10.55 g
$T_{3,}$ PM-09 × 72:28	13.49 ef	1.26 ab	1.21 e	2.72 b	11.40 d
$T_{14,}$ Masoor-2004 × 93:07	13.42 fg	0.77 f	1.30abcd	0.36 m	8.78 m
$T_{15,}$ Masoor-2004 × 86:14	13.16 i	0.87 e	1.27ab	0.72 jk	9.58 j
$T_{16,}$ Masoor-2004 × 79:21	13.28h	1.02 d	1.25 cd	1.07 h	10.37 h
$T_{17,}$ Masoor-2004 × 72:28	14.12 a	1.30 a	1.22 e	1.43 f	11.16 e
SE	0.04	0.02	0.03	0.03	0.03
LSD@5%	0.09	0.05	0.07	0.06	0.06

Physical properties of biscuits

The results of physical properties of lentil flour incorporated biscuits are presented in Table 4. The variation in the physico-chemical characteristics and sensory quality of biscuits was significantly increased ($P<0.05$) which is associated with the flour ratio as well as the variety of lentil. The physical analysis of biscuits showed that lentil variety PM-09 × 72:28 wheat: lentil ratio produced biscuits of maximum width (281.67 mm) and thickness (56.66 mm); biscuits prepared from variety Masoor-93 × 86:14 ratio showed maximum spread factor (79.33). The changes in width and thickness were revealed in spread ratio of biscuit. Spread ratio improved with the

addition of ingredients and wheat; lentil flour during mixing. There were significant differences ($p< 0.05$) among width as well as thickness of sample compared to all formulated biscuits.

Table 4: *Physical parameters of biscuits from different flour substitution.*

Wheat lentil flours ratios	Width (mm)	Thickness (mm)	Spread factor
T_1, Control	264.67 e	50.000 bc	53.0 f
T_2, Masoor-93 × 93:7	260.00 f	40.00 h	65.00 c
T_3, Masoor-93 × 86:14	275.00 b	35.00 i	79.3 a
T_4, Masoor-93 × 79:21	257.67 fg	37.00 i	70.00 b
T_5, Masoor-93 × 72:28	274.67 b	40.00 h	69.00 b
T_6, NIA-Masoor × 93:07	252.67 h	43.00 fg	59.00 d
T_7, NIA-Masoor × 86:14	255.00 gh	40.00 h	64.00 c
T_8, NIA-Masoor × 79:21	246.33 i	41.00 gh	60.00 d
T_9, NIA-Masoor × 72:28	270.00 c	51.00 b	53.00 f
T_{10}, PM-09 × 93:07	245.00 i	47.00 de	52.00 fg
T_{11}, PM-09 × 86:14	265.33 de	50.00 bc	52.00 fg
T_{12}, PM-09 × 79:21	264.67 e	52.00 b	50.33 gh
T_3, PM-09 × 72:28	281.67 a	56.66 a	50.00 gh
T_{14}, Masoor-2004 × 93:07	235.00 j	48.00 cd	49.00 h
T_{15}, Masoor-2004 × 86:14	257.00 fg	43.00 fg	60.00 d
T_{16}, Masoor-2004 × 79:21	266.72 cde	47.32 de	55.98 e
T_{17}, Masoor-2004 × 72:28	269.06 cd	44.84 ef	60.54 d

Chemical composition of biscuits

The results of chemical composition of lentil flour incorporate biscuits are presented in Table 5. The biscuits prepared from lentil variety Masoor-93 had the highest values for moisture (3.43%) and protein (6.40%) at 79:21 and 72:28 wheat: lentil flour ratio, respectively. Biscuits prepared from NIA-Masoor contained maximum ash, fiber and fat (0.95%, 3.57% 24.20%) at proportion ratio of 72:28, 72:28 and 93:07 wheat: lentil flour, respectively. Moisture content result for all the incorporated biscuits ranged from 2.50 to 1.90 %, significantly lower ($p > 0.05$) than that of control biscuits (3.17%). The protein content increased from 4.60 to 6.40 % with rising the concentration of flour in the mix (T_5, Masoor-93 × 72:28). The chemical characteristics, notably the protein, fat, ash contents of biscuits increased significantly with inclusion of lentil flour or increasing the ratio of lentil flour compared with the 100% wheat flour-based biscuit (control). The increase in protein content of incorporated biscuits might be the result of the higher protein content of wheat; lentil flour.

Sensory evaluations of biscuits

Sensory evaluations of lentil flour incorporate biscuits are presented in Table 6. The results of sensory evaluations showed that biscuits produced from lentil variety Masoor-93 at 93:07 wheat: lentil ratio ranked higher for colour (7.83), taste (7.50), flavor (7.50) as well as for overall acceptability (7.50) according to the preference of panelists. However, the texture ranked 7.50 was given to Masoor-2004 at 72:28 wheat: lentil flour ratio. Thus, incorporation of lentil flour improved significantly the taste of biscuits and this might be due to the taste of lentil which improved with cooking.

In this study, wheat flour-based biscuits were prepared and the chemical analysis showed that the protein and fat contents of biscuits increased significantly, compared with the control biscuit sample. The protein content demonstrated that it ranges from 4.02 to 6.40. The result found that, biscuits prepared from ratio 72:28 (T4) has the maximum protein content, while the quantity of protein decreasing as the quantity of Masoor flour increases. The increase in the protein content is due to the addition of lentil flour in wheat flour similar finding has been reported by Seema et al. (2015). The results are supported by the Anu et al. (2007) who reported that the protein content in supplemented biscuits were higher than wheat flour-based biscuits Further study by the Singh et al. (1991) and Tsen et al. (2006) stated that gram flour can simply be used to enhance the protein content in a variety of food products and found to be nutritious on the basis of chemical parameters. The concentration of fat in the biscuits ranged between 0.5g/100g and 3.11g/100g, with highest concentration of fat (3.57/100g) seen in biscuits reduced from T_9 at the ratio of 72:28 NIA-Masoor. All the biscuits prepared were found to be healthy on the basis of chemical parameters. Yadav et al. (2012) and Noor Aziah et al. (2012) reported that gram flour can easily be used to increase the protein content in various types of food products. Biscuits prepared from ratio T_4, Masoor-93 × 79:21 flour recorded the highest value (3.43%) of moisture; the lowest moisture content (1.31%) was recorded in biscuit made from T_{12}, (PM-09 × 79:21). These results are in accordance with those of Tsen et al. (2006) who reported that protein, fiber, fat, minerals and vitamins in biscuits are mainly dependent on the grain species used for obtaining flour; however, the change in the physical as well as chemical quality of the biscuits occurs with the mixing of flours.

Table 5: *The chemical composition of biscuits from different flour substitution.*

Wheat lentil flours ratio	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)
$T_{1,}$ Control	3.17 b	0.48 i	24.15 b	0.01 n	4.02 n
$T_{2,}$ Masoor-93 × 93:7	2.50 e	0.58Fgh	24.00 c	0.45 m	4.60 k
$T_{3,}$ Masoor-93 × 86:14	2.90 c	0.62efg	23.90de	0.67 l	5.20 h
$T_{4,}$ Masoor-93 × 79:21	3.43 a	0.78 c	23.82 g	0.98 ij	5.83 b
$T_{5,}$ Masoor-93 × 72:28	2.44 e	0.86 b	23.65 j	1.33 h	6.40 a
$T_{6,}$ NIA-Masoor × 93:07	1.68 j	0.65 ef	24.20 a	0.95 j	4.44 l
$T_{7,}$ NIA-Masoor × 86:14	2.76 d	0.69 de	24.02 c	1.92 e	4.88 i
$T_{8,}$ NIA-Masoor × 79:21	1.88 h	0.76 cd	23.92 d	2.79 c	5.33 f
$T_{9,}$ NIA-Masoor × 72:28	1.75 i	0.95 a	23.88ef	3.57 a	5.77 c
$T_{10,}$ PM-09 × 93:07	1.78 i	0.54 hi	24.01 c	0.51 m	4.43 l
$T_{11,}$ PM-09 × 86:14	1.71 ij	0.63efg	23.85fg	0.87 k	4.85 i
$T_{12,}$ PM-09 × 79:21	1.31 l	0.69 de	23.70 i	1.49 g	5.28 g
$T_{3,}$ PM-09 × 72:28	1.43 k	0.78 c	23.55 l	1.91 e	5.70 d
$T_{14,}$ Masoor-2004 × 93:07	2.22 f	0.56 gh	24.01 c	1.03 i	4.39 m
$T_{15,}$ Masoor-2004 × 86:14	2.01 g	0.61fgh	23.85 fg	1.63 f	4.79 j
$T_{16,}$ Masoor-2004 × 79:21	1.67 j	0.73 cd	23.75 h	2.47 d	5.18 h
$T_{17,}$ Masoor-2004 × 72:28	1.90 h	0.80 bc	23.60 k	3.11 b	5.58 e
SE	0.04	0.03	0.03	0.01	0.17
LSD@5%	0.09	0.07	0.03	0.06	0.03

Table 6: *Sensory evaluations of biscuits from different flour substitution.*

Wheat lentil flour ratio	Colour	Taste	Flavour	Texture	Overall acceptability
$T_{1,}$ Control	5.83def	6.00 c	6.00 d	6.17 cd	6.50abc
$T_{2,}$ Masoor-93 × 93:7	7.83 a	7.00 ab	7.00abc	6.83abcd	7.50 a
$T_{3,}$ Masoor-93 × 86:14	7.00abc	7.00 ab	6.33bcd	7.00abc	7.00 ab
$T_{4,}$ Masoor-93 × 79:21	7.00abc	6.33 bc	7.00abc	6.33 cd	7.00 ab
$T_{5,}$ Masoor-93 × 72:28	5.00efg	6.00c	6.00 d	6.00 d	6.00 bc
$T_{6,}$ NIA-Masoor × 93:07	7.00abc	6.00 c	6.33bcd	6.50bcd	6.50 abc
$T_{7,}$ NIA-Masoor × 86:14	6.33bcd	6.00 c	6.50bcd	6.33 cd	6.50abc
$T_{8,}$ NIA-Masoor × 79:21	7.00abc	6.00c	6.50bcd	6.50bcd	6.67abc
$T_{9,}$ NIA-Masoor × 72:28	6.00cde	5.00 d	6.00 d	6.00 d	5.50 c
$T_{10,}$ PM-09 × 93:07	6.50bcd	6.33 bc	6.00 d	6.00 d	6.00 bc
$T_{11,}$ PM-09 × 86:14	7.00abc	7.50 a	7.50 a	7.33 ab	7.50 a
$T_{12,}$ PM-09 × 79:21	4.83 fg	6.00 c	6.00 d	6.00 d	6.00 bc
$T_{3,}$ PM-09 × 72:28	4.50 g	6.00 c	6.00 d	6.00 d	6.00 bc
$T_{14,}$ Masoor-2004 × 93:07	7.00abc	6.16 bc	6.83abcd	4.33 e	6.00 bc
$T_{15,}$ Masoor-2004 × 86:14	7.33abc	6.00 c	6.16 cd	6.33cd	7.00 ab
$T_{16,}$ Masoor-2004 × 79:21	6.16 cd	7.33 a	7.16 ab	7.33 ab	7.50 a
$T_{17,}$ Masoor-2004 × 72:28	7.33 ab	7.00 ab	7.00abc	7.50 a	7.00 ab
SE	0.49	0.44	0.41	0.44	0.59
LSD@5%	1.00	0.90	0.84	0.91	1.20

The results are supported by the Kohajdova et al. (2013) they reported that the increase in moisture content of biscuits can be attributed to comparatively higher amount of fibre in gram flour than SGF. Fibre has strong affinity for water and products containing fibre will bind larger quantities of water.

The results concerning the physical evaluation of biscuits prepared from different levels of supplementation with gram flour are in agreement with Rababah et al. (2006) they acknowledged that decrease in the spread ratio as the concentration of gram flour increased in biscuits. Similar finding has been reported by Hussein et al. (2006) that the physico-chemical properties and quality of biscuits are influenced significantly (P<0.05) by mixing flour of different plant species including legume grains. Furthermore, the finding of the present study are in agreement to the results of Eissa et al. (2007) and Tiwari et al. (2011), who also reported similar effect on the thickness and diameter of kidney pea, chickpea, and pigeon pea flours substituted with wheat biscuits. Further, biscuits having higher spread ratios are considered most pleasing (Tiwari et al., 2011; Zucco et al., 2011). The decrease in spread ratio of supplemented biscuits might be due to the availability of more hydrophilic sites that compete for limited free water in biscuit dough prepared from high-protein flours (Amerine et al., 1965; Hoseney et al., 1988; Hooda and Jood, 2005) also reported that the spread factor of biscuits was decreased by increasing the supplementation levels of fenugreek flour in wheat flour The results of Sensory evaluations reveal that biscuits produced from wheat flour and lentil flour ratio are not significantly different (p≥0.05). The results of the evaluation revealed that there were no significant (p≥0.05) difference in taste and flavor between biscuits produced. The results are in conformity with the finding of the Lizarazo et al. (2014) and Grah et al. (2014) they also reported that lentil is added to a range of feed and food items in Europe that incorporation of lentil seed flour significantly improved the nutritional values, sensory (color and taste) and physical properties of wheat-based biscuits. The results for the all treatments reveal that there were no significant (p>0.05) difference in colour and overall acceptability among biscuits produced from different proportion ratio. Similar result reported by the (Snedecor et al., 1980; Khan et al., 1987; Chinma et al., 2012) in his sensory evaluation he used unripe plantain to addition wheat flour in the production of cookies; these results recommended that wheat flour might be supplement with different staple food samples in the production of biscuits and other.

Conclusions and Recommendations

Keeping in view all the above results, it may be concluded that the partial replacement of wheat flour with the lentil flour, the protein concentration and energy value were considerably increased. Specially at the levels of 21 and 28% were considered best because of the highest protein content. It may also be concluded that addition of lentil flour especially at the level of 21% was considered best by the panelists with respect to all sensory attributes. It is suggested that 21% lentil flour should be used in biscuits to provide value added products to consumer and to overcome protein malnutrition.

Author's Contribution

Gulnaz Saleem: Performed the experiment, collected data and draft the article.
Aijaz Hussain Soomro: Supervised the research, interpreted results and finalized the article.
Nouman Rashid: Supervision of data collection.
Mehar un Nisa Narejo: Reviewed the article.

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